

Returning from the cold

It sounds like science fiction: human beings preserved in containers of liquid nitrogen trying to beat the passage of time, eventually, being resuscitated and beginning a new life. This process has become a reality in Arizona, US, where Alcor, the world's largest cryonics company, caters to the desire of individuals wishing to conquer death and receive a second chance at life.

What will the world look like in two hundred or five thousand years? Most people have asked themselves this question at one point or other and sci-fi novels and films abound with visions of life in a far away future. But while titillating arm-chair travelling is enough for most people, some will do everything in their power, and spend a lot of money, to be able to set their foot on time-distant lands.

Almost one hundred people are currently in storage at Alcor Life Extension Foundation in Scottsdale, Arizona, in three-meter-high cylindrical containers filled with liquid nitrogen, awaiting a future that might allow their revival. Alcor refers to its clients as “patients” since they are not dead but “suspended.” The terminology is based on the insight that life and death are not binary “on-off” states, and that death is not an event, but rather a process.

Not dead: suspended

Generally speaking, death occurs when the body's chemistry becomes so disorganized that normal operation cannot be restored. Up to the present, this has been believed to be the case four to six minutes after cardiac arrest because after several minutes it is difficult to resuscitate the brain. Chemical disorganization of the human body, can, however, be halted, and the intervals between cardiac arrest and death are becoming longer and longer.

Medical research has shown that more than ten minutes of warm cardiac arrest can now be survived without any brain injury, and adult humans have reportedly survived cooling to temperatures that stop the heart, brain, and all other organs from functioning for up to an hour.

Alcor accordingly claims that their clients are not dead but “suspended” in the interval between life and death, and that it may be possible to restore them to full health when new technology is developed in the future.

“A stopped heart only causes death if nothing is done when the heart stops.”

(from the Alcor homepage)



“Cryonics is not a belief that the dead can be revived. Cryonics is a belief that no one is really dead until the information content of the brain is lost, that low temperatures can prevent this loss.”

(from the Alcor homepage)

Every minute counts/replacing the blood by cryoprotectants

In order for ischemic injury to be as slight as possible, every minute counts after a client’s heart has stopped beating. As soon as an independent nurse or physician has pronounced legal death, the Alcor standby team will place the body in an ice-water bath and restore blood circulation and breathing with a heart-lung resuscitator. Intravenously a series of medications, notably anticoagulants, nitric oxide synthase inhibitors, and anesthetics, are administered to help maintain blood pressure, reduce brain oxygen consumption and protect the brain from reperfusion injury. A heat exchanger in the heart-lung machine reduces the body’s temperature to a few degrees above zero, at which oxygen is no longer necessary.

At the Foundation, a surgeon connects major blood vessels to a perfusion circuit, and blood is replaced with an organ preservation solution called M22. It contains cryoprotectants, which prevent freezing during deep cooling and thus damage to cells through ice crystal formation. This procedure, in which 60% of all water in the cells is replaced by the cryoprotectant solution, is called vitrification.

Meanwhile, the status of the brain is visually monitored through two small holes drilled in the skull. As Alcor reports, a healthy brain will slightly retract from the skull in response to cryoprotectant perfusion, and its surface is pearly white in color.

After complete cryoprotective perfusion, the patient is cooled to a temperature of -124 degrees Celsius, at which she or he will have “vitrified”, ie reached a stable ice-free state. The patient is then further cooled to -196 degrees Celsius over approximately two weeks. Finally, he or she is put into an aluminum container which, in turn, is placed in a steel tank filled with liquid nitrogen. This is where the body is permanently stored.

THE BASIS OF CRYONICS

Life can be stopped and restarted if its basic structure is preserved.

Vitrification (not freezing) can preserve biological structure very well.

Methods for repairing structure at the molecular level can now be foreseen.





“Life can be stopped and restarted under the right conditions.”

(from the Alcor homepage)

High incidence of imperfect cases

Described above is the ideal course of procedures. Alcor has, however, a high incidence of imperfect cases, ie, the majority of Alcor patients have suffered cerebral injury of some kind and hence arguably stand a slim chance of new life in the future.

The main reason is that despite a network of affiliated doctors and hospices, Alcor has little control over the time that elapses between a member’s legal death and admission to the Foundation. For example, a patient may be in a hospital which allows prompt access by a transport team, so post-mortem cardiopulmonary support and cooling can begin immediately.

Long transport times may negate quick initial response by an affiliated doctor, and hours in which a patient with cardiac arrest has remained undiscovered may outweigh any advantage of rapid transport and cryoprotective perfusion at Alcor.

Hopes in “wet nanotechnology”

To reverse imperfect preservation, Alcor sets high hopes in “wet nanotechnology.” Cryonicists trust that natural self-repair of cells, tissues, and organs is not all that will ever exist in medicine. Rather, cell repair augmentation by drugs, synthetic enzymes, viruses, and macrophage is hoped to eventually bring forth devices capable of extensive tissue regeneration, including repair of individual cells.

Given the fact that every tissue and organ in the body can in principle be regenerated, cryonicists also believe that medicine will one day even be able to regrow lost limbs and organs in situ. In the best case, an entire body could be regenerated around, for example, an unconscious brain maintained in a fluid life support system—which is why Alcor also cryopreserves brains without bodies.

Speculative by nature

Although cryonics uses various techniques that are widely used in current medicine, particularly in cryobiology, the majority of scientists are dismissive both of the procedures and the “science” because it is speculative by nature. Why support something for which we have no proof? Generally, in medicine, a technique is first studied, validated, and perfected before it is applied clinically. Cryonics, however, rushes to apply a technique based on theoretical arguments rather than validated clinical effectiveness.

Also, cryonics has a “tabloid journalism” flavor for many scientists which inhibits involvement with it. In the US, the Society for Cryobiology has discouraged members from doing research that could advance cryonics, and has adopted a bylaw that threatens to expel any person who practices or promotes cryonics.

Whole body cryopreservation from USD 150,000

Alcor’s clients know about the shortcomings and uncertainties of cryonics, yet still opt for it. They pay a minimum of USD 150,000 for whole body cryopreservation, or a minimum of USD 80,000 for neurocryopreservation, ie, preservation of the brain.

For members from outside the US, Canada, and the United Kingdom, surcharges apply. Membership fees are USD 398 annually, and there is an additional standby charge for all rescue activities up through the time the legally pronounced member is delivered to the Alcor operating room, which costs USD 120 annually.

Cryopreservation is not only for the wealthy, though. As Alcor states on their website, most membership is middle class and funds cryonics through life insurance policies which name Alcor as the beneficiary. Still, there are quite a few rich and famous members (see box), among them also Hall of Fame baseball legend Ted Williams, who has been cryonically suspended at the Foundation since 2003.

Precisely in connection with Ted Williams there has recently been bad press about Alcor. A new book with the title “Frozen,” written by a former employee of Alcor, claims

“The goal of cryonics is to overcome serious illness by preserving and protecting life. Cryonics is therefore consistent with pro-life principles of both medicine and religion.”

(from the Alcor homepage)

the athlete’s head was mistreated during cryopreservation procedures at the Foundation. Alcor has denied the allegations and promised legal action.

Williams and other Alcor members probably would not mind too much, though. They not only embrace the somewhat gory aspects of preservation procedures but also share resilience and an invincible optimism about human beings and their capacity to shape their own and the world’s fate.

KEY CRYONICS TERMS

cryonics: (from Greek kryos = cold) preservation of organisms and organs (usually the brain) at low temperatures (below -125 degrees Celsius) in order to resuscitate them in the future.

cryoprotectants: chemicals that prevent the formation of ice crystals in the body during deep cooling.

M22: a highly stable vitrification solution used for kidney cryopreservation, currently used by the Alcor Life Extension Foundation for cryoprotective perfusion of bodies and brains.

vitrification: replacement of the blood by a cryoprotectant solution.

patient: person stored in a container in liquid nitrogen.

cryonic suspension: a person’s status after legal death and vitrification, before restoration to full life and health.



FAMOUS ALCOR MEMBERS

Cryopreserved Alcor members include Dick Clair, an Emmy Award-winning television sitcom writer and producer, baseball legend Ted Williams and his son John Henry Williams and Futurist FM-2030.

Current members of Alcor include nanotechnology pioneer Eric Drexler, internet pioneer Ralph Merkle, engineer Keith Henson and his family, MIT professor Marvin Minsky, aging researcher Aubrey de Grey, mathematician Edward O. Thorp, computer security CEO Kenneth Weiss, casino owner Don Laughlin, inventor Ray Kurzweil, film director Charles Matthau, futurists Max More and Natasha Vita-More, and entrepreneurs Saul Kent, Luke Nosek, and Future Electronics founder Robert Miller.

Magazine publisher Althea Flynt was signed up to Alcor, but her body was not able to be preserved after her death because it required an autopsy.

Alcor homepage: www.alcor.org

Other cryonics companies: www.cryonics.org/comparisons.html